EMP AND THE PORTABLE TRANSISTOR RADIO

by A. D. Perryman
Scientific Advisory Branch

The long-range effects of electromagnetic pulses generated by nuclear weapons detonated outside the earth's atmosphere call into question the vulnerability of all types of communications systems and equipments–in particular, the portable transistor radio, which many of us possess and will rely on in a nuclear crisis to receive information and advice from the Government. The following questions spring to mind; will transistor radios survive the powerful electromagnetic pulses emitted by nuclear weapons; are there certain modes of operation to be avoided if damage is to be minimised; what components are most vulnerable to EMP and can receivers be hardened to withstand EMP?

In an attempt to answer some of these questions SAB carried out a limited programme of tests in which four popular brands of transistor radio were exposed in an EMP simulator to threat-level pulses of electric field gradient about 50 kV/m.

The receivers were purchased from the current stock of a typical retailer. They comprised:

1. a low-price pocket set of the type popular with teenagers
2. a Japanese set in the midde-price range
3. a domestic type portable in the upper-price range
4. an expensive and sophisticated portable receiver.

All these sets worked on dry cells and had internal ferrite aerials for medium and long wave reception. In addition, sets 2, 3 and 4 had extendible whip aerials for VHF/FM reception. Set 3 also had one short wave band and set 4 two short wave bands.

The test programme was somewhat constrained by financial and manpower limitations and by limits on the availability of the simulator and so the experimentation was restricted to the following:

(a) before each test, examination of each receiver in controlled workshop conditions so as to establish performance characteristics

(b) during each test, subjective assessment of overall performance degradation immediately after exposure to EMP

(c) after each test, a similar examination to (a), including identification of components that failed, wholly or partly, and their cause of failure.

During the tests the receivers were first tuned to a well-known long-wave station and then subjected to a sequence of pulses in the EMP simulator. This test was repeated on the medium wave and VHF bands. Set 1 had no VHF facility and was therefore operated only on long and medium waves.

The results of this experimentation showed that transistor radios of the type tested, when operated on long or medium waves, suffer little loss of performance. This could be attributed to the properties of the ferrite aerial and its associated circuitry (e.g. the relatively low coupling efficiency). Set 1, in fact, survived all the several pulses applied to it, whereas sets 2, 3 and 4 all failed soon after their whip aerials were extended for VHF reception. The cause of failure was identified as burnout of the transistors in the VHF RF amplifier stage. Examination of these transistors under an electron microscope revealed deformation of their internal structure due to the passage of excessive current transients (estimated at up to 100 amps).

Components other than transistors (e.g. capacitors, inductors etc.) appeared to be unaffected by the number of EM pulses applied in these tests.

From this very limited test programme transistor radios would appear to have a high probability of survival in a nuclear crisis when operated on long and medium bands using the internal ferrite aerial. If VHF ranges have to be used, then probably the safest mode of operation is with the whip aerial extended to the minimum length necessary to give just audible reception with the volume control fully up.

Hardening of personal transistor radios is theoretically possible and implies good design practice (e.g. shielding, bonding, earthing, filtering etc.) incorporated at the time of manufacture. Such receivers are not currently available on the popular market.

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CONTENTS

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